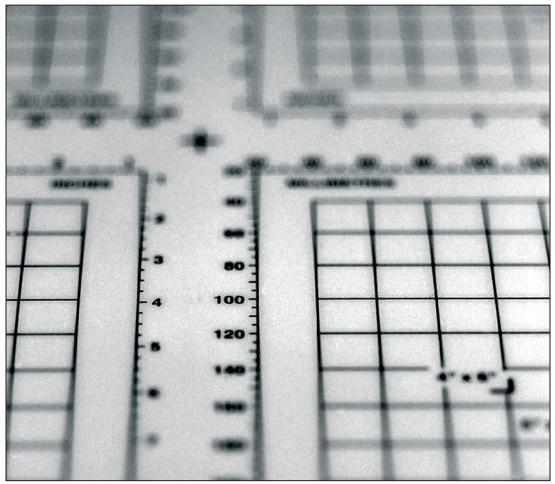
Critical Focusing

What you see is what you get?

Prior to picture taking, we typically focus the image on a view screen, and during the actual exposure, the image is projected onto the sensor plane. While doing so, we take for granted that view screen and sensor plane, despite residing at two different locations, have the same distance from the lens.

Camera manufacturing is about balancing process capabilities with customer expectations to achieve a required mechanical accuracy within acceptable tolerances. In addition, all mechanical devices are subject to unavoidable wear and tear, which require periodic adjustment or replacement. To manufacture within tolerance is no guarantee that the product will stay that way for the life of the product. Within twelve months, we once had to adjust a professional medium format SLR, two medium-format rangefinders and a well-known make of 35mm rangefinder. One of these cameras was brand-new. After being adjusted, they all focus perfectly, putting the initial camera setup in question, and proving that the following test method is valid.



What Is Reasonable?

Take, for example, a 90mm, f/2 lens on a 35mm rangefinder. Clearly, the f/2 aperture is not for viewing brightness, but is designed for picture taking too. The tolerances of the camera body, lens and photographer add up. The human element in any focus mechanism provides opportunity for error, but it is not an unreasonable assumption that the mechanical focus accuracy should be within the depth of field at the maximum lens aperture. With the 90mm lens at the minimum focus distance, the acceptable depth of field is 10 mm at most. For a portrait, this is the difference between acceptable and unacceptable eye sharpness. The alignment between view screen and film plane must be well within the depth of focus, which in this example, is a tight tolerance of less than ±0.05 mm or the thickness of a human hair.

A Simple Focus Target

For any kind of focus check, we need to be able to set up the camera with perfect repeatability. A good focus target must be easy to focus on and, at the same time, indicate the magnitude of error in focus. This suggests a series of horizontal markings along the optical axis. However, since most split-image and range-finder screens are better at determining vertical than horizontal lines, adding a series of vertical lines makes good sense. Put these together and you get a grid.

Rather than drawing a unique grid, we can use a piece of graph paper, our cutting-mat scale or the grid on our enlarger easel, all of which make adequate focus targets. For this example (fig.1), we use the grid on an enlarging easel,

fig.1 (far left)The grid of an enlarging easel or a cutting board makes for a simple but acceptable focus target for checking critical camera focus.

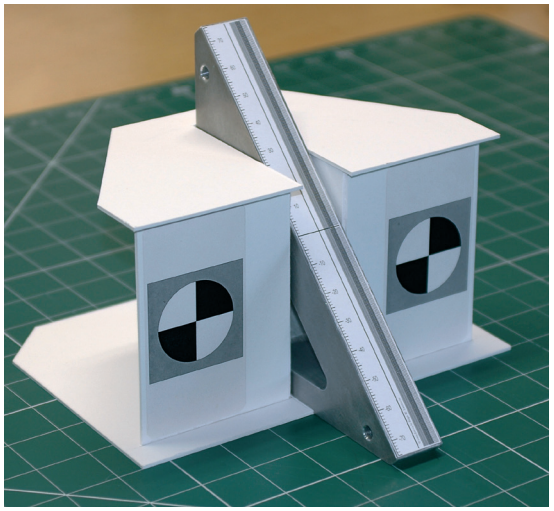


fig.6 (above)An advanced focus target provides quantifiable results and is easily built from mount board scraps.

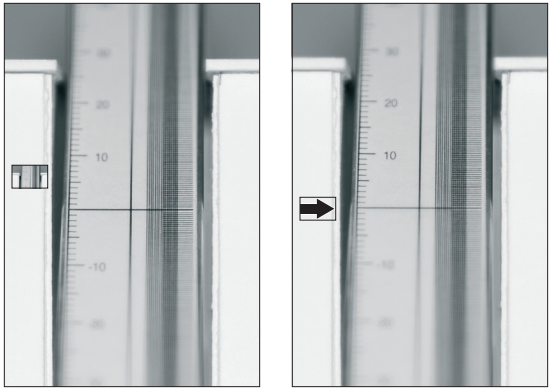


fig.7 (above)These test images were taken from a distance of 935 mm at f/1.8 with an 85mm lens (m=0.1). The image on the left shows a far-sighted focusing error of about 5.5 mm (0.6%), prior to camera adjustment. The image on the right verifies perfect focus after adjustment.

which is a white piece of plastic with fine, black grid lines in 20mm increments.

The camera is set up on a tripod and carefully focused on the 100mm mark, using the vertical lines for critical adjustment. Additionally, the camera is at an angle of about 30° to the easel plane and close to the minimum focus distance. One benefit of focusing range-finder cameras is immediately apparent when viewing the grid. Since the range-finder and view-finder window have a different perspective on the grid, the vertical grid lines have different slants and seem to cross over at the point of focus. Consequently, this enables extremely accurate focus adjustment. With split-image viewfinders, position the split line on the focus point.

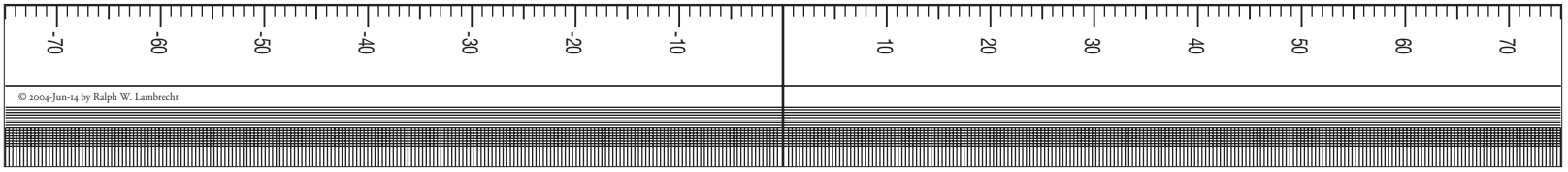
As can be seen in fig.1, the gradual blurring of the vertical lines clearly identifies the focus point along the scale, aiding accurate focus measurement. At the same time, it is possible to estimate the range of useful focus at this short range.

We suggest that you repeat the test a few times to ensure your technique. With range-finder cameras, try arriving at perfect focus from near and far distance settings, to check for any play in the mechanism.

An Advanced Focus Target

A simple focus target, such as the grid on our enlarger easel in fig.1, is more than adequate to verify camera focus once in a while. But, if you intend to conduct

fig.8 (below)This is she advanced focus scale at full size. It is already elongated along the horizontal axis to be at the right dimensions if viewed foreshortened under 45°.



a lot of focus testing, or you need quantifiable results, you might want to invest the time in building a more sophisticated focus target. As an example, our advanced focus target in fig.6 provides repeatable and quantifiable results and is easily made within an hour or two.

As shown in fig.6, take some mat-board scraps and construct a 45° triangle from it. Make it about 25 mm thick and 150 mm tall. Then, copy the focus scale in fig.8 and glue it to the long side of the triangle. The focus scale is elongated along the vertical axis to be at the correct dimensions if viewed foreshortened under 45°. Building the surrounding support is an option, which makes repeatable focusing a lot easier. When using a support, make sure the focus planes of the support structure line up with the zero marking on the focus scale, before you level the camera and take the picture with a wide-open aperture.

Fig.7 shows two sample test images. The image on the left shows a far-sighted focusing error of about 5.5 mm, prior to the camera adjustment. The image on the right verifies perfect focus after such adjustment.

A Practical Hints

Focusing a camera in low-light situations is not an easy task. We would like to share a proven technique, which works well even in the darkest church interiors.

Purchase two small flashlights for your camera bag. Mag Instrument is a popular brand, which comes in many sizes. Unscrew the tops, which turns them into miniature torches, and place them upright into the scene at the two extremes of the desired depth of field (see fig.9). Focusing on the bright, bare bulbs is simple, no matter how dark the location is. It is good to know that,With modern auto focus systems, You have little to nothing to worry about. So far,I have never been able to beat my Nikon auto-focus system with a manually focused setting. I trust my camera's auto-focus completely, even with moving objects. The only reason I upgraded from my old 1970s Nikkor lenses was that the newer versions of the same focal length offer auto-focus capabilities,

photography is about the **visual impact** upon the viewer not about sharpness.

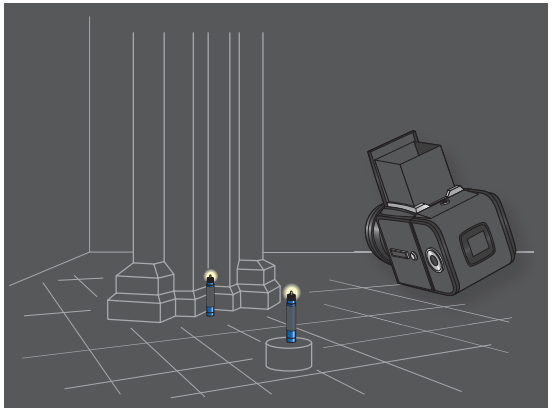


fig.9 (above)Focusing on the bright bulbs of miniature flashlights is simple, no matter how dark the location is.

Never rely on depth of field (DOF) for p**erfect sharpness**. A subject is only rendered truly sharp when it is accurately focused on. Everything else is always a compromise of acceptable sharpness.